

Incorporate Solution Batching into Heterogeneous Computing to solve the QAP Optimization Problem

Gary Yu-Hsin Chen

Department of Logistics Management
National Kaohsiung University of Science and Technology
Kaohsiung 82445, Taiwan
garychen@nkust.edu.tw

Ping-Shun Chen

Department of Industrial and Systems Engineering
Chung Yuan Christian University
Chung Li 32087, Taiwan
pingshun@cycu.edu.tw

Abstract

Parallel computing involving central processing units (CPUs) and graphics processing units (GPUs), known as heterogeneous computing, can greatly improve computational efficiency across various scientific and engineering domains. The heterogeneous computing platform best suits algorithms requiring sequential and parallel processing. A GPU with shallow pipelines, short caches, and numerous threads doing sequential tasks is connected to a CPU with a more complex hardware design via a PCIe bus. It is crucial to note that the complexity of heterogeneous computing and the time cost of transporting input data to the GPU for processing and obtaining output results from the GPU is useless if the time cost is greater than the savings from processing the data on the GPU. Therefore, to take advantage of heterogeneous computing, the best candidates for optimization problems are those that compute on the same data multiple times. In this research, the researchers proposed the concept of “solution batching” to take advantage of fewer data transfer operations between the CPU and GPU. The quadratic assignment problem (QAP) is utilized to verify the suitability of the innovative technique in improving heterogeneous computing. Additionally, the nature of the QAP problem and solution batching, the obstacles and difficulties, and the possibility of implementation will also be covered in this investigation.

Keywords

Heterogeneous Computing, Quadratic Assignment Problem, Solution Batching, C++ AMP, Graphics Processing Unit

Acknowledgments

This research is supported by the National Science and Technology Council, Taiwan, under contract numbers MOST 111-2221-E-992-039- and NSTC 112-2221-E-992-037-.

Biographies

Gary Yu-Hsin Chen is a full professor in the Department of Logistics Management at the National Kaohsiung University of Science and Technology, Taiwan, ROC. He obtained a PhD from the Department of Industrial,

Manufacturing and Systems Engineering, University of Texas at Arlington, USA. His research area focuses on operations research, meta-heuristics, and software testing and quality assurance.

Ping-Shun Chen is a full professor in the Department of Industrial and Systems Engineering at Chung Yuan Christian University, Taiwan, ROC. He obtained a PhD from the Department of Industrial and Systems Engineering, Texas A&M University, USA. His research area focuses on network programming or applications, supply chain management, healthcare applications, and system simulation.